Commentary Articles

Valuation, Appraisal, Discounting, Obsolescence and Depreciation

Towards a Life Cycle Analysis and Impact Assessment of Their Effects on the Environment of Cities

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Abstract

Previous editions of this Journal have drawn attention to the critical role valuation plays in life cycle analysis and environmental impact assessment (see for example VOLKWEIN and KLÖPFFER [1]). In particular, the critical role of valuation has been highlighed in a number of discussions on 'valuation step' within life cycle costing, 'hedonic and contingency' assessments of environmental impact and both the utility and welfare of 'pathway' analysis/assessment (KREWITT, MAYERHOFER, TRUKENMÜLLER and FRIEDRICH, 1998; POWELL, PEARCE and CRAIGHILL, 1997; VOLKWEIN, GIHR and KLÖPFFER, 1996 [2-4]). Focusing on the utility of market valuation, this paper examines the critique of discounting environmentalists have made in relation to property valuation, investment appraisal and the application of the principle in the income based net annual return model of land use time-horizons and the spatial configuration of building programmes – a criticism implict in 'valuation step', 'hedonic, contingency' and 'pathway' analysis/assessments. It examines the argument put forward regarding the link between the selection of a discount rate, the valuation of property, appraisal of investment and inter-generational downloading of costs associated with the use of land, repair, maintenance and refurbishment of buildings: the downloading of costs, seen by some, to have an adverse impact and work against the introduction of experimental designs aimed at energy saving, clean air environments.

Keywords: Appraisal; discounting, Life Cycle Assessment; environmental impact assessment; valuation

1 Introduction

The paper begins by examining the valuation and appraisal issue in question, goes on to examine the debate over the discounting principle, reviews the environmental and sustainability measures it is supposed to work against, even frustrate and exposes some of the contradictions in the position the critics set out. Having done this, it then goes on to advance a framework of analysis for life cycle analysis which has the potential to circumvent many of the criticisms about the utility of market based valuation and appraisal models put forward for life cycle analysis and environmental impact assessment [5-8].

2 Time Horizons, the Spatial Configuration and Rate of Redevelopment

In reference to the discounting principle, Harvey (1989) points out that:

"In general terms (re)development takes place when the present value of the existing flow of future net returns from the existing use of land resources becomes less than the capital value of the cleared site. We have therefore to calculate the present value of the land resources in their current use and compare this with the value of the cleared site, it must be emphasised that we are seeking to establish capital net return expected to be earned in future years, such returns must first be estimated and discounted for the present value and then aggregated" [9].

From this initial statement on the discounting principle, Harvey (1989) formulates a simple income model of property valuation. In this model it is the notion of net annual returns, or what he refers to as NARs that take a leading role in the appraisal of investments and rate of (re)development in the time-horizons and spatial configuration of land uses and building programmes (see also BALCHIN, BULL and KIEVE [10]). As a form of income, the NAR is defined as the difference between gross annual returns (such as rent received) and operating costs (including repairs, maintenance, insurance and other such outgoings). To operationalise the notion of net income as an annual return in terms of property valuation and investment appraisal, he proposes that all gross annual returns and operating costs should be projected over the life-time of the land use, or building programme in question. Before subjecting the NARs to a rate of discount, he makes some comments on the nature of the relationship between the gross annual returns and operating costs. What he proposes is that over the life of the land use the gross annual return (GAR) will fall and operating costs will rise. He represents this notion as an annual return given by:

$$P = \sum_{i=i}^{n} \frac{R_i - O_i}{(1+r)^i} \quad (1)$$

Where:

P = value of property in its current land use
n = period when GARs can be earned in its current use
Ri = GARs from i to year n
Oi = operating costs, excluding obsolescence and depreciation, from i to year n
r = rate of discount.

A formula which represents the valuation of property as a method of investment appraisal and procedure to follow in the discounting of returns and calculation of present value. In terms of cleared site value, it is proposed that the value of the cleared site is equal to the present value of the most profitable alternative use, less the cost of clearing the site and rebuilding for the new use. The residual method of property valuation and procedure to be followed in the appraisal of investments required for this calculation are represented in the formula:

$$C = \sum_{I=i}^{n} \frac{R_i' - O_i'}{(1+r)^I} - D - B \qquad (2)$$

where:

C = the value of the cleared site
n = period when GARs can be earned until alternative use
Ri = GARs from i to year n
Oi = operating costs, excluding obsolescence and depreciation, from i to year n
r = rate of discount
D = the cost of demolition and clearing the site
B = the cost of rebuilding to the new, alternative land use

3 The Dynamics of Life Cycle Analysis

Taking the NAR model to represent a form of life cycle analysis it is possible to show when the redevelopment of land uses and programme of building required for such purposes takes place (→ *Fig. 1*). As **Figure 1** illustrates, from year R the value of the cleared site is positive and increasing and eventually at T it is seen to exceed the present value of the land in its current use. As a result redevelopment takes place in year T, where PV equals VCS.

As Harvey (1989) is keen to point out, at T the land use is still technically efficient, for it can receive a NAR until year Z. However, in year T it becomes inefficient in economic terms because resources can be redeployed, or switched to an alternative, new land use having a higher present value. As he points out, under these circumstances the present value of the current and cleared site bring about a situation where the time-horizon of a land use is represented as OT and position whereby it is possible to calculate how many years the technical and economic life of a building programme is efficient. Under normal circumstances the spatial configuration of land uses are found to be concentrated in the city centre and that any alternative, new use which follows from a programme of building takes the form of an expansion from the centre to the periphery.

With regards to the rate of redevelopment, it is stressed this is far more difficult to predict and is contingent on a number of factors. First the level of demand from occupiers and investors; second: operating costs and thirdly: the rate of interest. Ignoring the first two categories, he goes on to examine the effect a change in the rate of interest has on the present value of current land uses, cleared sites, time-horizon and spatial configuration of building programmes.

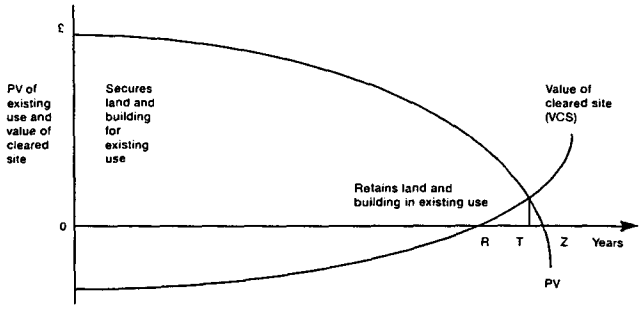

Fig. 1: The timing of redevelopment

4 Land Use, Building Obsolescence and Depreciation

Perhaps the most obvious and immediate significance of this examination is that it introduces a variable not yet taken into account in the NAR model of property valuation and investment appraisal i.e. obsolescence and depreciation. However it should be recognised that the significance of obsolescence is much deeper than the addition of further expenditures on the cost of outgoings associated with land use and building programmes. This is because it represents the outcome of a much deeper enquiry into the adoption of discount rates, the so-called initial yield and nature of uncertainty and risk in property valuation and investment appraisal. As an approach to the valuation of property and appraisal of investment, the income thesis draws upon Fisher's (1965) representation of the discounting principle and interest payments the investment of capital yields in terms of a 'rate of return'. Such payments are seen to represent a return for: (a) the loss of liquidity; (b) the payment for the foregoing of immediate consumption and switching of capital into investment. A payment also referred to as the 'risk free rate' because it represents the payment for the foregoing of consumption and investment of capital in riskless operations unaffected by inflation; (c) anticipated inflation and compensation for the loss of real value; (d) the premium which reflects the degree of risk associated with a particular investment opportunity [11].

Based on this Fisher's (1965) theory of interest, the rate of return is represented as:

$r = l + i + p$

where:

l	=	loss of liquidity
i	=	anticipated inflation
p	=	the risk premium.

Given the valuation of property and appraisal of investment does not allow for real rates of return, only notional, it is proposed there is no requirement for i and R can be represented as the sum of l + p. Responding to Gordon (1982) and adding in rental growth to the equation, a risk, growth and deprecation explicit model of property valuation as a rational pricing mechanism in the appraisal of investments is put forward (see BAUM and CROSBY, 1988 [12]). This is represented as follows:

$K = RFR + r^*-g+d$

where:

K	=	the initial yield on capital investment
RFR	=	the risk free, inflation prone opportunity cost rate of return
r^*	=	risk premium
g	=	expected annual rate of rental growth in new land uses and building programmes
d	=	depreciation in the capital component of land use i.e. the building and not the land. This is because land is seen to represent the non-reproducible resource that commands a scarcity value and transfer earnings payment from (re)development potential. This can, of course, be severely restricted if the land in question is subject to contamination and obsolete in the sense of representing an environmental hazard.

Here the risk-free, inflation prone opportunity cost rate of return is taken to be the redemption yield on government securities and the premium is the additional return for investment of capital in property. The proposal for g to represent the expected annual rate of rental growth in new land uses and building programmes is made so as to allow the depreciation component to be measured in terms of the obsolescence a particular use, or programme has been subject to.

The formula is important for two reasons. First, K is equivalent to the r in the NAR model previously referred to. Looked at in this way, r appears to be a far more complex figure than initially thought. It appears, however, to be one it is necessary to live with if the criticisms of the model's silence on such matters as uncertainty, risk, rental growth and depreciation are to be overcome. Secondly, in taking the form of a summation equation (one which takes the first three criticisms into account), it also works within the definitions of physical deterioration, technical, economic and environmental obsolescence, put forward by the RICS, ISVA and Centre for Advanced Land Use Studies (CALUS) to explain the causes of depreciation [13-14]. Causal factors Baum (1991) is of the opinion are impossible to single out, but can be represented in terms of: (a) physical deterioration (b) external appearance (c) internal specification and (d) configuration. Factors which Baum (1991) argues need to be weighted in order of significance so that the impact of low and high flexibility can be analysed in terms of the impact depreciation has on rental values, yields, expenditure and risk [15].

5 The Debate over Environmental Impact Assessment

The last section's examination has sought to identify that a number of developments have taken place in property valuation and investment appraisal which circumvent many of the criticisms aimed at the NAR model. In particular the fact that by substituting the r of the NAR model in the valuation of property with that of the initial yield (shown by symbol K) in the depreciation sensitive model of investment appraisal, it is possible to be not only risk and growth explicit, but depreciation explicit too. Balanced against this, however, is the fact that this reformulation of r in terms of the initial yield has little to say about the time-horizons, spatial configuration of land uses, or building programmes. What is also noticeable is the tendency for both approaches to say little, if anything about whether or not they represent a net benefit or make a contribution to welfare. This question is, of course, looked at briefly under the issue surrounding rate of return over cost. But given neither of the approaches address spill-over effects, or externalities in any way whatsoever, it has to be recognised any claims in this department have to be balanced against the fact the discount rate (in whatever forms of surfaces i.e. the r of the NAR models, the K of the initial yield, or the plain old rate of interest!) are private and in that sense reflect private as opposed to social time preferences regarding the marginal productivity of capital.

This is worth reiterating because it is the life cycle analysis issue of time-horizons, spatial configurations, spillovers, externalities and the social dimension of the discounting principle (and the way it ought to influence property valuation and investment appraisal) that is of particular concern to those with an interest in environmental impact assessment (for example; RYDIN, 1992; VALE, 1993 and BREHNEY, 1993 respectively [16-17]).

Working within this terms of reference, Rydin (1992) has sought to examine the life cycle and environmental impact assessment issues of property valuation and investment appraisal in market economies. Quoting Pearce and Turner (1990), it is proposed that:

"the use of discounting downgrades costs to future generations at the expense of benefits to the current generation. Thus the expense of future maintenance will have a relatively smaller impact on the value of an investment compared with current capital expenditure. This form of valuation can inhibit many forms of refurbishment which would enhance energy conservation and undervalue buildings which minimise their environmental impact" [18].

The contradiction, Rydin (1992) seeks to expose is that the economics of discounting in property valuation and investment appraisal tends to work against the possibility of introducing experimental designs aimed at low carbon and fossil fuel content because the benefits they provide in long term, repair, maintenance and running costs do not translate into any additional rental income, or a favourable yield adjustment, but merely additional capital costs. This is seen as contradictory because: (a) the so-called tyranny of the discounting principle tends to militate against the introduction of such experimental designs; (b) it inhibits improvements and refurbishments aimed at low carbon, fossil fuels consumption; (c) it leads to high repair, maintenance and overall running costs without any compensatory income; (d) tends to negate the possibility of offsetting deterioration, obsolescence and depreciation in a manner that brings about long term horizons and more compact spatial configurations; (e) downloads private and social costs associated with land use and building programmes to future generations to the benefit of the current. As a critique of the discounting principle it draws upon the research of Pearce and Turner (1990). As it is a concern that leads Rydin (1992) to advocate a lower discount rate, initial yield or level of interest for environmentally-friendly, green land use and building programmes, it is a critique which requires further attention.

Pearce and Turner's (1990) criticism of the discounting principle is five-fold: (a) that private individuals can measure the pure time preference for present consumption as opposed to future investments; (b) the lack of consideration given by the marginal efficiency theory of capital to social time preference; (c) the lack of any specific allowance for uncertainty and risk in the choice of the discount rate; (d) the tendency to ignore that a positive, initial yield or rate of interest on capital investment assumes growth; (e) the fact that discount rates have an in built tendency to place a high value on current income and a low weighting to future capital and revenue costs.

Looked at independently, it is evident that the first four criticisms are economic in nature. What is also clear is that the last point has little to do with either technical or economic efficiency and in referring to such matters as the downloading of inter-generational costs, takes a moral, or ethical line. Irrespective of this however, what they recognise is that:

"The implication of the criticisms is that we should lower discount rates from whatever they are when determined by the STPR (Social Time Preference Rate) and SOC (Social Opportunity Cost) arguments. If we accept this we have an immediate problem in that the criticisms do not tell us by how much we should lower discount rates. We are left with an indeterminate theory of discount rate selection" [19].

In an attempt to circumvent this problem, it is proposed that an alternative to the question of adjusting discount rates should be looked at. It is proposed that attention should focus not so much on the adjustment to the discount rate, but on the sustainability requirement property valuation and investment appraisal needs to meet in order for it to take account of the impact land use and building programmes have on the environment. To focus, that is, not so much on the discount rate, which has led to the failure of government policy in for example; the planned expansion of the central business district into the inner-city, but on what is required to reconcile this situation and lead to a position where life cycle analysis and environmental impact assessment have a time-horizon, spatial configuration and rate of (re)development which is more sustainable.

6 The Contradictions

The paper suggests that there exist a number of contradictions in the environmentalist's critique of the discounting principle which lies behind the valuation of property and appraisal of investments. The contradictions in question take a number of forms. First factual inaccuracies regarding the discounting principle in property valuation and investment appraisal. Secondly, the tendency to abandon NAR type models of property valuation, investment appraisal and their measure of both technical and economic efficiency as measurements of welfare, without any suitable replacement. Thirdly, the tendency to bracket questions of efficiency and welfare improvements within a given distribution of income in favour of matters concerning equity.

Rydin's (1992) criticism of the discounting principle in the valuation of property and appraisal of investments represents it as being at odds with, or working against the possibility of having time-horizons and spatial configurations (of land-use and building programmes) as part of a (re)development process whose impact on the environment of cities is ever going to be capable of meeting the sustainability requirement. To support this line of reason she draws upon the critique of the discounting principle advanced by Pearce and Turner (1990): in particular the criticisms regarding the lack of due consideration given to the marginal efficiency of capital, social time preference, uncertainty, risk and growth.

What, however, is most noticeable is that Pearce and Turner (1990) do not agree with the arguments put forward to support a discount rate adjustment, but instead focus attention on what they refer to as the sustainability requirement of property valuation and investment appraisal. Based on this there can be no simple assumption (as RYDIN, 1992 appears to make) that the possible benefits of life cycle analysis and impact assessment for environmentally-friendly, green land uses and building programmes call for downward adjustments to discount rates, increases in capital value to offset additional expenditure on longer time-horizons and more compact spatial configurations: something which somehow and in some way, is seen to bring about a situation where the marginal productivity of capital in terms of income return over cost, yields a rate of interest that equates private individual with social time preference. However, even putting this to one side, it is evident that Pearce and Turner's (1990) criticisms do not take

into account the significant advances which have been made with regards to property valuation and investment appraisal in the contemporary era. You only have to look at the Fisher inspired formula for the initial yield of Baum (1991) and Baum and MacGregor (1992) to see that in the contemporary era property valuation and investment appraisal does take uncertainty and risk into consideration and also acknowledges that growth is another component in the rate of interest [20].

Indeed if we follow this line of reason through, it soon becomes clear that any downward adjustment to the rate of discount is based on the assumption the valuation of property and appraisal of investments will give rise to land uses and building programmes which are not only more efficient in both technical and economic terms, or bring about a welfare improvement, but a level of growth sufficient enough (relative to depreciation) to sustain the yield as a rate of interest on the capital in question. It in fact assumes a lower level of risk and high rate of growth, a situation that tends to draw additional, not fewer, scarce, fixed and finite resources into the (re)development process. It is perhaps for this reason that Pearce and Turner (1990) draw the conclusion that the criticism of the discounting principle indicates there is something 'a miss' with the rates of return selected, but 'does not add up to much' and choose instead to focus attention on the sustainability requirement.

7 Meeting the Sustainability Requirement

As O'Brian, Doig and Clift's (1996) contribution to the debate points out, the 'meeting of the sustainability requirement', is what most of the discussions on the critical role of valuation have in common [21]. As they also suggest, where they differ is in the method each proposes should be adopted for such purposes. With this matter firmly in mind, Volkwein, Gihr and Klöpffer (1996) propose the adoption of 'valuation step', Powell, Pearce and Craighill advocate the use of 'hedonic and contingency' method, while Krewitt, Mayerhofer, Trukenmüller and Friedrich (1998) apply 'pathway' analysis/assessment. As O'Brian, Doig and Clift (1996) point out, the main reason for rejecting any other form of methodology rests in the belief they suffer from the tyranny of the discounting principle, are in that sense too abstract, over-generalised and unhelpful in the somewhat deterministic and reductionalist way they simplify the analysis and assessment techniques which are needed to value the impact (re)developments have upon the environment. This understanding is if a little less explicitly also reflected in the rejection of market models as the basis of life cycle analysis and environmental impact assessment appearing under the title of 'valuation step', 'contingency, hedonic' and 'pathway' analysis/assessment. The difficulty with this rejection of market-based models is that it is founded upon a incomplete, somewhat questionable critique of the discounting principle and which on reflection adds up to little more than a suggestion the abstract and over-generalised nature of property valuation and investment appraisal means it is not possible for a detailed life cycle analysis or environmental impact assessment to meet the sustainability requirement. If it can be accepted that there are a number of contradictions in the critique of the discounting principle which leave the question of a meaningful relationship between not only the technology and economy of market valuation, but the environment open, then it becomes worthwhile searching for a means to bridge the gap that exists between the market and environment. To, in effect, adopt income-based NAR type models of property valuation and investment appraisal, with forms of life cycle analysis and environmental impact assessment that not only make it possible for (re)developments to yield an income which is efficient in terms of time-horizons and spatial configurations, but also equitable in their inter-generation loading of costs. That is, meet the 'normalisation, time, space and hazard' (efficiency and equity) provisions under the valuation step, hedonic, contingency and pathway models surrounding the life cycle analysis and environmental impact assessment previously referred to. Put in slightly different and perhaps more dramatic terms, **meet both the market and environmental** (efficiency and equity) criteria required for the (re)development process in question to be sustainable and in that sense illustrate a moral and ethical code which is socially acceptable.

8 Towards a Framework for Analysis

So far it has been suggested that the debate over economic theory and its application in the principle of discounting, property valuation and investment appraisal (obsolescence and depreciation also) has tended to become separated from issues concerning the use of land, programme of building and the impact the redevelopment process has on the environment of cities. It has also been argued that any attempts to progress the matter should be firmly grounded in the former and draw upon what is understood about valuation methodology, investment techniques etc to advance our knowledge of the latter via life cycle analysis and environmental impact assessment. It is for this reason the paper proposes that a framework for analysis should be grounded in a form of welfare economics which provides the opportunity for a detailed examination of meaningful relationships between the dynamics of the time-horizons and spatial configurations of what have been referred to as land use, building obsolescence, depreciation and expenditure. That is, of how depreciation reacts back on repairs, maintenance, improvements etc or, from the NAR model's point of view, the relationships between (l + r) and O. The relationship Rydin (1992) is critical of and appears to be of particular interest to Vale (1993). Accepting that Rydin's criticisms and call for downward adjustments to r are not supported by Pearce and Turner (1990) and, indeed, leaves the whole question wide open, it is possible to argue the best way to further any common interest in the debate over environmental impact assessment (and in that sense the sustainability requirement) is through a closer examination of the relationship between O and r, the discount rate.

In terms of the NAR notion of net income, it is only possible at this stage to qualify the equation so that r represents K= RFR + r* - g + d. While this will be common for both equations (1) and (2), it will also affect Ri and Oi due to the fact r will be net of obsolescence and depreciation. While the modifications appear minor and perhaps insignificant, it is proposed that their true value lies in the fact the adjusted NAR model addresses many of the criticisms made about the tyranny and determinism of the discounting principle and selection of an appropriate rate; draws particular attention to both risk and growth in setting the return on capital and, in so doing, makes it possible for the rate of interest to surface from the life cycle analysis and environmental impact assessments undertaken rather than the other way around [22].

The following lists the potential benefits of any such examination: (a) it would focus attention on the nature of the relationships between O and r in the NAR model; (b) it would build upon the advances of contemporary property valuation and investment appraisals not only in terms of the income approach to risk and growth, but the cost based thesis on outgoings associated with capital expenditure on repairs, maintenance, improvements and refurbishments; (c) the collection of information on such expenditure would augment our understanding of depreciation; (d) it would also make it possible for the benefits of contemporary property valuation and investment appraisal to be formally integrated into the field of development analysis – something it may be difficult to believe has not yet been delivered;(e) such data would also allow life cycle exercises to be undertaken in the valuation of property, appraisal of investments, obsolescence and depreciation and also be capable of incorporating the 'step','hedonic, contingency' and 'pathway' dimensions into the measurement of any impact land use and building programmes required for (re)development purposes have on the environment of cities; (f) such a schedule of costing would provide information for the valuation and appraisal of the initial capital and subsequent revenue expenditures in terms of outgoings associated with clean air technologies. The effect of this on occupational demand for land uses and building programmes and demand for property due to its value as an investment may also be analysed; (g) the with/without logic of comparative analysis could also be drawn upon to establish not so much the potential, but real effects of introducing such technologies. This would identify what value the market puts on such technologies. That is, what price, both users and investors are willing to pay for the income-benefits of such attributes. It would also demonstrate the cost of not taking such a course of action. Something which could be measured in terms of the different present values of those properties with and without the technologies in question. While, of course, this does not account for the spillover, or external costs/benefits associated with such a course of action, it ought to be possible to satisfy this by some form of step, hedonic, contingency or pathway exercise as the basis of a life cycle analysis and environmental impact assessment geared towards a willingness to accept the inter-generational loading in question. The effect this form of property valuation, combining, as it does, both market and environmental concerns, has on the appraisal of investments will also need to be placed under examination; (h) RFR + r* gives an indication of the parameters i.e. upper and lower levels of the discount rate, r, or initial yield K, whereas g provides an indication of anticipated growth. The significance of this being that both variables are linked into the capital markets of the economy and provide the opportunity to estimate the effect any change in the relationship between O and r will have not just upon the time-horizons and spatial configuration of land use and building programmes (for example; the income benefits of longer time-horizons, more compact spatial configurations, lower risk, greater growth and cost-savings from reduced rates of obsolescence and depreciation) in a given city, but on the country as a whole. The same is true for equation (2), but here the effect also extends into D and B. Here again the effect of the cost of introducing such new technologies into an alternative land use and building programme could be analysed to establish at what point the income benefits become efficient in technical and economic terms and equitable from the environmental point of view.

This list of considerations does not of course exhaust all the issues in question, it merely sets out a framework for analysis that makes it possible to circumvent many of the criticisms made about the discounting principle which underlies the NAR model of property valuation and investment appraisal, its particular representation of the temporal and spatial dimensions to the land use and building programmes and of particular concern to those with an interest in life cycle analysis and environmental impact assessment. The interest represented in the property valuation and investment appraisal of this adjusted NAR type model and also reflected in the valuation step, hedonic, contingency and pathway approaches to life cycle analysis and environmental impact assessment.

What this adjusted NAR model does is turn the principle of 'the polluter pays' around by introducing the means by which those agents of change in the market (i.e. designers, engineers, contractors, planners, etc.) can provide land use and building programmes with environmentally-friendly, green technologies and mechanisms (the life cycle analysis and environmental impact assessments underlying this form of property valuation and investment appraisal) that **not only value, in both economic and social terms, the efficiency and equity of such contributions to the marginal productivity of capital, but compensate them with a rate of return the market sees as fair and is also just from the environmental point of view.** Without this and **what is in effect an environmentally-friendly, green pricing mechanism,** it would not be possible to overcome the legacy of market failure in dealing with public goods and link the means with the ends i.e. the market basis of the property valuation and investment appraisal underlying the adjusted NAR model with the time-horizons and spatial configurations of environmentally-friendly, green technologies for land use and building programmes. That is, **show 'how it pays',**

in both market and public policy terms, to introduce such environmentally-friendly, green technologies with lower carbon-based emissions. Without this link it would not be possible to demonstrate the range of opportunities open for the state to finance welfare improvements of this kind and **utilise the real value**, in technical, economic or social terms, of either the efficiency or equity such an environment offers the public for an enhanced quality of life.

9 Conclusions

This paper has examined the critique of the discounting principle environmentalists have made in relation to property valuation, investment appraisal and its application in the income based NAR model of land use time-horizons and the spatial configuration of building programmes. In particular it has looked at the link made between the selection of a discount rate, the valuation of property, appraisal of investment and the inter-generation downloading of costs associated with the use of land, repair, maintenance and refurbishment of buildings. In examining this debate it has found the criticism wanting and has sought to expose some of the contradictions within the argument that it is this downloading of cost which works against the introduction of experimental designs aimed at environmentally-friendly, green land uses and building programmes. In doing so the paper has also sought to demonstrate the connection made between the discounting principle, valuation of property, appraisal of investment and downloading of costs is tenuous and open to question.

In addition to this, it is hoped the paper provides a means to strengthen the relationship between life cycle analysis, environmental impact assessment, valuation and appraisal in the context of previous discussions surrounding such matters. With this in mind, it has sought to alay any fears those responsible for valuations and appraisals might have about using NAR type models by focusing attention on the positive contribution market based valuations and appraisals can make to life cycle analysis and environmental impact assessment. This is an important point because given the undue criticism they have attracted there is some doubt about the utility of such models. The outcome of this being seen in the switch of attention away from NAR type models of market valuation towards environmental based methods and gap that has, as a consequence, been left between the market and environment. The gap which needs of be bridged if valuation, be it through the conjuncture of an 'adjusted NAR type model', 'stepped', 'hedonic, contingency', or 'pathway' analysis/assessment, is to provide a (re)development process capable of meeting the sustainability requirement.

Postscript

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